PB-240 510

SWAN LAKE, ITASCA COUNTY, MINNESOTA

Pacific Northwest Environmental Research Laboratory

Prepared for:

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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I

REPORT
ON
SWAN LAKE
ITASCA COUNTY
MINNESOTA
EPA REGION V
WORKING PAPER No. 129

WITH THE COOPERATION OF THE
MINNESOTA POLLUTION CONTROL AGENCY
AND THE
MINNESOTA NATIONAL GUARD

DECEMBER, 1974

II

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

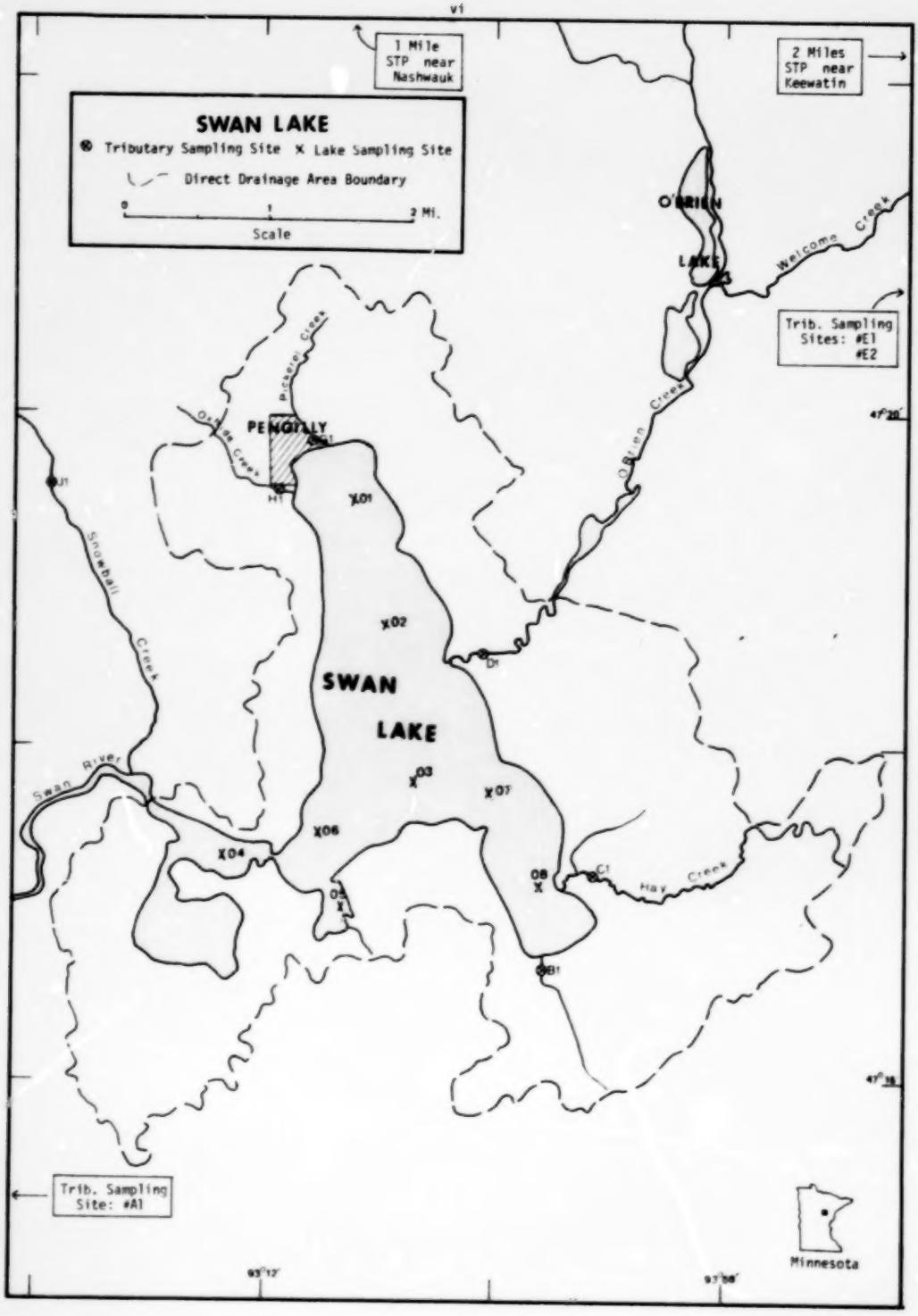
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


1 Mile STP near Nashwauk
2 Miles STP near Keewatin
SWAN LAKE
Tributary Sampling Site
Lake Sampling Site
Direct Drainage Area Boundary
0
1
2 Mi.
Scale
O'BRIEN LAKE
Welcome Creek
Trib. Sampling Sites: #E1 #E2
Pigeon Creek
Orange Creek
PENGILLY
O'Brien Creek
Snowball Creek
SWAN LAKE
Swan River
Hay Creek
Trib. Sampling Site: #A1
Minnesota
47°20'
47°10'
93°12'
93°08'

SWAN LAKE

STORET NO. 2788

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Swan Lake is mesotrophic. Of the 60 Minnesota lakes sampled in the fall of 1972, when essentially all were well-mixed, two had less mean total phosphorus, three had less mean dissolved phosphorus, and three had less mean inorganic nitrogen. Of the 80 Minnesota lakes sampled, one had greater Secchi disc transparency, and one had less mean chlorophyll a. Depression of oxygen with depth occurred during the summer sampling.

Survey limnologists did not observe any aquatic nuisances during the three sampling visits.

B. Rate-Limiting Nutrient:

The results of the algal assay indicate nitrogen limitation at the time the sample was collected.

The lake data indicate phosphorus limitation in July and nitrogen limitation in September and October.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Swan Lake received a total phosphorus load at a rate in excess of the rate proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see

page 13). It is calculated that three point sources--Nashwauk, Keewaten, and Cooley--collectively contributed about 64% of the load.

A reduction of 80% in the municipal point-source phosphorus loads would reduce the loading rate to about 2 lbs/acre/yr or 0.23 $g/m^2/yr$. This rate is an oligotrophic rate and, if achieved, should result in a significant improvement in the trophic condition of Swan Lake.

2. Non-point sources (see page 13)--The phosphorus exports of the Swan Lake tributaries were comparatively low during the sampling year.

In all, it is estimated that non-point sources contributed about 34% of the total phosphorus load to Swan Lake during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 2,615 acres.
2. Mean depth: 39.8 feet.
3. Maximum depth: 60 feet.
4. Volume: 104,077 acre/feet.
5. Mean hydraulic retention time: 2.4 years.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Hay Creek	25.1 mi^2	13.9 cfs
O'Brien Creek	42.9 mi^2	23.5 cfs
Pickerel Creek	1.2 mi^2	0.6 cfs
Oxhide Creek	7.7 mi^2	3.5 cfs
Snowball Creek	6.6 mi^2	3.3 cfs
Unnamed Creek (B-1)	12.5 mi^2	7.0 cfs
Minor tributaries & immediate drainage -	13.2 mi^2	8.6 cfs
Totals	109.2 mi^2	60.4 cfs

2. Outlet -

Swan River	113.3 mi^2**	60.4 cfs

C. Precipitation***:

1. Year of sampling: 22.6 inches.
2. Mean annual: 25.7 inches.

† McGuire, 1973; mean depth by random-dot method.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake; adjusted to equal sum of subdrainage areas.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Swan Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from at least two stations on the lake and from a number of depths at each station (see map, page vi); a total of eight stations were sampled during the September period. During each visit, a single depth-integrated (15 feet or near bottom to surface) sample was composited from the two stations (eight stations in September) for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 45 feet at station 1, 54 feet at station 2, 49 feet at station 3, 10 feet at station 4, 12 feet at station 5, 34 feet at station 6, 50 feet at station 7, and 25 feet at station 8.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	FALL VALUES (10/22/72) Mean	Median	Maximum
Temperature (Cent.)	6.9	7.0	7.0	7.2
Dissolved oxygen (mg/l)	10.0	10.2	10.2	10.2
Conductivity (μmhos)	180	191	190	200
pH (units)	8.0	8.1	8.1	8.1
Alkalinity (mg/l)	78	79	79	81
Total P (mg/l)	0.003	0.014	0.015	0.017
Dissolved P (mg/l)	0.002	0.009	0.009	0.013
NO_2 + NO_3 (mg/l)	0.040	0.041	0.040	0.050
Ammonia (mg/l)	0.040	0.043	0.040	0.050
		ALL VALUES		
Secchi disc (inches)	70	115	120	144

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
07/12/72	1. Microcystis	1,103
	2. Anabaena	452
	3. Flagellates	253
	4. Dinobryon	190
	5. Cyclotella	90
	Other genera	290
	Total	2,378
09/09/72	1. Microcystis	600
	2. Dinobryon	398
	3. Melosira	282
	4. Flagellates	116
	5. Cyclotella	51
	Other genera	325
	Total	1,772
10/22/72	1. Flagellates	1,533
	2. Anabaena	1,382
	3. Chroococcus	1,231
	4. Fragilaria	427
	5. Dinobryon	352
	Other genera	2,110
	Total	7,035

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
07/12/72	01	*
	02	*
09/09/72	01	1.9
	02	2.3
	03	1.1
	04	3.4
	05	5.1
	06	1.8
	07	2.8
	08	4.8
10/22/72	01	7.3
	02	7.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)	N/P Ratio
Control	0.015	0.070	2.0	5/1
0.005P	0.020	0.070	2.4	4/1
0.010 P	0.025	0.070	1.9	3/1
0.020 P	0.035	0.070	2.1	2/1
0.050 P	0.065	0.070	2.3	1/1
0.050 P + 10.0 N	0.065	10.070	29.2	155/1

* Samples lost.

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Swan Lake was moderate at the time the assay sample was collected. The lack of increase in yield with increased orthophosphorus, and the significant increase in yield when both nitrogen and phosphorus were added, indicate nitrogen limitation (note the N/P ratios). The customary 10.0 mg/l nitrogen spike was set up for this assay, but a lack of growth response in the sample indicates the nitrogen spike was inadvertently omitted.

The lake data indicate nitrogen limitation in September (N/P ratio = 10/1) and October (N/P = 9/1) but phosphorus limitation in July (N/P = 14/1).

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in October, 1972, and was completed in October, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the means of the nutrient loads, in $lbs/mi^2/year$, at stations B-1, C-1, and J-1 and multiplying the means by the ZZ area in mi^2.

Note that Snowball Creek was sampled during the Survey; but this stream joins the Swan River at or below the physical outlet of the lake, and the nutrient loads do not affect the lake and are not shown in the loading tables. However, since the "outlet" sampling station (A-1) was downstream from the confluence of Snowball Creek the nutrient loads attributed

* See Working Paper No. 1.

to the Swan Lake outlet are those measured at station A-1 minus the Snowball Creek loads.

The calculated nutrient loadings at station D-1 on O'Brien Creek were about equal to the measured loadings from the Nashwauk wastewater treatment plant. Therefore, background loadings for O'Brien Creek were based on the mean loadings obtained at stations C-1 and B-1. All of the nutrients from the Nashwauk wastewater treatment plant were assumed to have reached the lake during the sampling year.

The operator of the Nashwauk wastewater treatment plant provided monthly effluent samples and corresponding flow data. However, the villages of Keewatin and Cooley did not participate in the Survey, and nutrient loads were estimated at 2.5 lbs P and 7.5 lbs N/capita/year for Keewatin and 3.5 lbs P and 9.4 lbs N/capita/year for Cooley.

The Village of Pengilly has no municipal system and was assumed to be served by septic tanks.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Nashwauk	1,341	act. sludge	0.252	O'Brien Creek
Keewatin	1,382	trickling filter	0.138*	Welcome Creek
Cooley	33	none	0.003*	Pickerel Creek

2. Known industrial - None

† McGuire, 1973.
* Estimated at 100 gal/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Hay Creek	1,210	11.0
O'Brien Creek	1,310	11.9
Pickerel Creek	30	0.3
Oxhide Creek	120	1.2
Unnamed Creek (B-1)	240	2.2
b. Minor tributaries & immediate drainage (non-point load) -	400	3.6
c. Known municipal STP's -		
Nashwauk	3,460	31.5
Keewatin	3,460	31.5
Cooley	120	1.2
d. Septic tanks* -	210	1.9
e. Known industrial - None	-	-
f. Direct precipitation** -	410	3.7
Total	10,970	100.0

2. Outputs -

Lake outlet - Swan River 2,320

3. Net annual P accumulation - 8,650 pounds

* Estimate based on 308 shoreline dwellings plus 1970 Pengilly population of 80; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Hay Creek	40,550	22.8
O'Brien Creek	45,930	25.7
Pickerel Creek	1,430	0.8
Oxhide Creek	11,960	6.7
Unnamed Creek (B-1)	10,110	5.7
b. Minor tributaries & immediate drainage (non-point load) -	14,130	7.8
c. Known municipal STP's -		
Nashwauk	10,810	6.0
Keewatin	10,360	5.8
Cooley	310	0.2
d. Septic tanks* -	7,990	4.5
e. Known industrial - None	-	-
f. Direct precipitation** -	25,190	14.0
Total	178,770	100.0

2. Outputs -

Lake outlet - Swan River 74,010

3. Net annual N accumulation - 104,760 pounds

* Estimate based on 308 shoreline dwellings plus 1970 Pengilly population of 80; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainge Area:

Tributary	lbs $P/mi^2/yr$	lbs $N/mi^2/yr$
Hay Creek	47	1,628
Pickerel Creek	25	1,192
Oxhide Creek	25	1,516
Snowball Creek	26	744
Unnamed Creek (B-1)	18	794

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligtrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	4.2	3.3	68.4	40.1
grams/m^2/yr	0.47	0.37	7.7	4.5

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Swan Lake:

"Dangerous" (eutrophic rate)	0.44
"Permissible" (oligotrophic rate)	0.22

V. LITERATURE REVIEWED

Anonymous, 1974. Wastewater disposal facilities inventory. MPCA, Minneapolis.

McGuire, John F., 1973. Personal communication (point sources; physical and biological characteristics of Swan Lake). MPCA, Minneapolis.

Miller, Richard D., 1962. Report on investigation of pollution of Swan Lake, Itasca County. Dept. of Health, Minneapolis.

Schilling, Joel, 1974. Personal communication (lake map). MPCA, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schweiz A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27RR SWAN LAKE

TOTAL DRAINAGE AREA OF LAKE 114.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
27RRA1	114.00	23.20	20.64	28.22	220.68	137.33	94.62	38.36	22.16	19.03	52.57	36.94	30.97	60.36
27RRH1	12.50	2.95	2.30	3.37	22.90	16.20	11.20	4.65	2.55	2.65	6.41	4.05	4.17	6.95
27RRC1	25.10	5.42	4.44	6.44	47.70	32.40	22.30	9.24	5.09	4.99	12.50	8.23	7.70	13.87
27RRD1	42.90	9.10	8.00	10.90	86.10	53.90	36.60	14.90	8.60	7.40	20.50	14.40	12.00	23.52
27RRG1	1.21	0.19	0.12	0.37	2.00	1.41	1.13	0.41	0.17	0.24	0.44	0.24	0.29	0.58
27RRH1	7.74	0.63	0.46	1.45	13.80	8.84	6.97	2.49	1.06	1.29	2.60	1.59	1.21	3.53
27RRJ1	6.57	0.97	0.74	1.39	11.70	8.23	5.92	2.34	1.19	1.35	3.00	1.83	1.65	3.36
27RR27	17.30	3.21	2.47	4.02	31.00	19.50	15.00	5.72	2.81	3.07	7.02	4.43	4.45	8.56

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 114.00
SUM OF SUB-DRAINAGE AREAS = 113.34

TOTAL FLOW IN = 724.65
TOTAL FLOW OUT = 724.72

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27RRA1	10	72	25.40	14	19.00				
	11	72	41.30	14	39.00				
	12	72	40.70						
	1	73	48.30	9	48.00				
	2	73	43.50	14	43.00				
	3	73	62.90	17	93.00				
	4	73	75.90	5	72.00	19	62.00		
	5	73	121.00	5	73.00	20	109.00		
	6	73	79.50	14	64.00				
	7	73	[illegible]	26	31.00				
	8	73	2.14	23	54.00				
	9	73	1.25						
27RR41	10	72	2.45	14	2.20				
	11	72	4.27	14	4.00				
	12	72	5.19						
	1	73	5.41	9	5.80				
	2	73	4.37	14	4.50				
	3	73	7.11	17	10.00				
	4	73	6.47	5	7.00	19	6.00		
	5	73	13.40	5	8.00	20	12.00		
	6	73	8.95	14	7.80				
	7	73	4.09	26	4.70				
	8	73	5.58	23	3.90				
	9	73	3.41						

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TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

[illegible] CODE 2788 [illegible]

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27880]	10	72	5.74	14	4.32				
	11	72	8.57	19	8.10				
	12	72	9.80						
	1	73	10.70						
	2	73	8.44	18	8.83				
	3	73	13.50	17	20.00				
	4	73	14.30	5	15.00	19	12.00		
	5	73	26.90	5	16.00	20	24.00		
	6	73	17.80	14	16.00				
	7	73	8.13	26	9.40				
	8	73	11.20	20	11.80				
	9	73	6.24						
27880]	10	72	9.40	14	7.00				
	11	72	15.20	19	14.00				
	12	72	15.00						
	1	73	17.90						
	2	73	15.20	18	16.00				
	3	73	23.00	17	34.00				
	4	73	26.10	5	26.00	19	23.00		
	5	73	44.50	5	27.00	20	40.00		
	6	73	29.30	14	26.00				
	7	73	13.10	26	15.10				
	8	73	18.90	20	19.70				
	9	73	9.35						
27883]	10	72	0.20	14	0.20				
	11	72	0.26	19	0.20				
	12	72	0.36						
	1	73	0.37						
	2	73	0.23	18	0.20				
	3	73	0.73	17	1.20				
	4	73	0.60	5	0.60	19	0.60		
	5	73	1.17	5	0.70	20	1.00		
	6	73	0.40	14	0.40				
	7	73	0.34	26	0.41				
	8	73	0.37	20	0.34				
	9	73	0.30						
27884]	10	72	1.20	14	0.90				
	11	72	1.67	19	1.60				
	12	72	1.61						
	1	73	1.24						
	2	73	0.87	18	0.80				
	3	73	3.06	17	4.50				
	4	73	4.14	5	4.20	19	3.60		
	5	73	7.14	5	4.40	20	6.60		
	6	73	5.58	14	4.80				
	7	73	2.13	26	2.51				
	8	73	3.13	20	2.40				
	9	73	1.61						

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TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27RR SWAN LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27RRJ1	10	72	1.38	14	1.00				
	11	72	1.93	19	1.80				
	12	72	2.06						
	1	73	1.91						
	2	73	1.45	18	1.50				
	3	73	2.93	17	4.30				
	4	73	3.51	5	3.60	19	3.00		
	5	73	6.83	5	4.10	20	6.20		
	6	73	4.74	14	4.10				
	7	73	2.06	26	2.40				
	8	73	2.61	20	2.70				
	9	73	1.69						
27RRZ7	10	72	3.23	14	2.40				
	11	72	4.67	19	4.40				
	12	72	5.55						
	1	73	6.32	9	6.30				
	2	73	4.69	18	4.90				
	3	73	8.48	17	13.00				
	4	73	9.30	5	9.50	19	8.10		
	5	73	16.20	5	9.70	20	15.00		
	6	73	12.00	14	10.00				
	7	73	5.03	26	5.80				
	8	73	6.15	20	6.50				
	9	73	3.84	17	0.93				

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APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

278801
47 19 29.0 093 11 12.0
SWAN LAKE
27 MINNESOTA

LIEPALES 2111202
3 0037 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/12	20	15 0000			120							
	20	15 0004	21.3	8.0		170	7.70	79	0.040	0.050	0.016	0.007
	20	15 0015	17.3	2.4		170	6.80	74	0.180	0.050	0.022	0.009
	20	15 0030	10.0	2.6		170	6.40	75	0.180	0.050	0.014	0.010
	20	15 0044	6.4			170	6.30	78	0.300	0.080	0.047	0.031
72/09/09	08	20 0000			132	190	7.70	83	0.040	0.040	0.010	0.008
	08	20 0004	17.1	7.6		195	7.70	82	0.040	0.030	0.011	0.008
	08	20 0015	17.2	7.7		195	7.75	82	0.030	0.030	0.011	0.008
	08	20 0024	17.2	7.8		193	7.70	82	0.040	0.030	0.011	0.008
	08	20 0033	14.9	3.2		193	7.10	80	0.080	0.050	0.011	0.008
72/10/22	16	00 0000			87	200	8.10	81	0.040	0.040	0.017	0.010
	16	00 0004	7.2	10.2		190	8.10	79	0.040	0.040	0.017	0.011
	16	00 0015	7.2	10.2		190	8.00	78	0.040	0.040	0.015	0.003
	16	00 0025	7.2	10.0		190	8.00	79	0.050	0.050	0.003	0.002
	16	00 0045	7.2	10.1		190	8.00	78	0.040	0.050	0.013	0.009

20

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/ /24	08	20 0000	1.9J
72/10/22	16	00 0000	7.3J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

278802
47 18 45.0 093 10 55.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/12	20	40 0000			120							
	20	40 0004	21.5	7.6		160	7.70	70	0.050	0.030	0.012	0.011
	20	40 0015	21.3	6.0		170	7.70	70	0.010K	0.010K	0.014	0.009
	20	40 0041	6.6	0.4		175	6.40	75	0.300	0.050	0.034	0.023
72/09/09	08	55 0000			144	197	7.80	83	0.040	0.040	0.012	0.009
	08	55 0004	17.5			199	7.78	83	0.030	0.030	0.014	0.008
	08	55 0015	17.5			193	7.80	84	0.030	0.030	0.012	0.008
	08	55 0022	17.5	6.8		190	7.80	83	0.030	0.040	0.011	0.009
	08	55 0029	16.7	6.2		190	7.50	81	0.040	0.050	0.010	0.006
	08	55 0035	12.9	1.1		190	6.95	78	0.120	0.070	0.012	0.009
	08	55 0041	9.4	0.5		190	6.90	77	0.170	0.100	0.023	0.018
	08	55 0048	7.4	0.4		200	6.95	86	0.160	0.210	0.052	0.043
	08	55 0054	7.2	0.4		200	7.00	85	0.150	0.240	0.075	0.064
72/10/22	15	30 0000			70	200	8.10	79	0.040	0.040	0.012	0.009
	15	30 0004	6.9	10.2		190	8.10	78	0.040	0.040	0.015	0.009
	15	30 0015	6.9	10.2		190	8.10	79	0.040	0.040	0.015	0.012
	15	30 0020	6.9	10.2		180	8.10	79	0.040	0.040	0.016	0.012
	15	30 0035	6.9	10.2		190	8.10	79	0.040	0.050	0.016	0.013

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	08	55 0000	2.3J
72/10/22	15	30 0000	7.6J

K VALUE KNOWN TO BE LESS THAN INDICATED

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

278803
47 17 48.0 093 10 40.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0053 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/09/09	09 35	0000			132	185	7.70	79	0.030	0.050	0.008	0.004
	09 35	0004	17.6	7.9		185	7.78	77	0.030	0.040	0.010	0.005
	09 35	0015	17.5	7.8		190	7.71	77	0.030	0.040	0.010	0.005
	09 35	0022	17.4	6.5		192	7.62	79	0.060	0.060	0.011	0.007
	09 35	0030	15.5	4.4		192	7.20	77	0.070	0.070	0.012	0.007
	09 35	0039	8.9	0.2		199	6.92	81	0.150	0.230	0.057	0.043
	09 35	0049	7.3	0.4		200	6.98	79	0.150	0.240	0.071	0.042

22

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	09 35	0000	1.1J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

278804
47 17 22.0 093 12 18.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0014 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/09/09	11 20	0000			96	195	7.80	82	0.030	0.040	0.017	0.010
	11 20	0004	17.6	8.5		188	7.90	80	0.030	0.050	0.021	0.008
	11 20	0010	17.3	9.4		188	7.85	78	0.020	0.050	0.023	0.009

23

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	11 20	0030	3.4J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

278805
47 17 06.0 093 11 33.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0016 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/09/09	11	35 0000			108	193	7.83	82	0.020	0.030	0.013	0.008
	11	35 0004	17.2	10.8		190	7.80	80	0.030	0.030	0.018	0.009
	11	35 0012	17.2	8.2		185	7.80	80	0.030	0.040	0.016	0.009

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	11	35 0000	5.1J

J VALUE KNOWN TO BE [illegible] ERROR

STORET RETRIEVAL DATE 74/10/30

278806
47 17 30.0 093 11 30.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0038 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/09/09	11 50	0000			132	198	7.85	79	0.030	0.040	0.012	0.008
	11 50	0004	17.5	7.7		190	7.80	79	0.030	0.020	0.013	0.009
	11 50	0015	17.4	7.7		198	7.70	79	0.040	0.040	0.012	0.008
	11 50	0022	17.0	6.5		190	7.55	79	0.060	0.040	0.012	0.007
	11 50	0027	16.7	0.5		190	6.95	77	0.160	0.090	0.020	0.014
	11 50	0034	10.5	0.1		193	6.95	78	0.140	0.110	0.029	0.016

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	11 50	0000	1.8J

J VALUE K[illegible]

STORET RETRIEVAL DATE 74/10/30

278807
47 17 45.0 093 10 00.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0054 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/09/09	12	20 0000			120	198	7.82	83	0.030	0.050	0.012	0.006
	12	20 0004	17.8	8.4		198	7.82	80	0.020	0.050	0.015	0.006
	12	20 0015	17.7	8.2		190	7.80	82	0.020	0.040	0.012	0.007
	12	20 0022	17.6	7.9		195	7.75	83	0.030	0.050	0.011	0.007
	12	20 0030	12.7	0.7		190	6.95	76	0.140	0.070	0.016	0.011
	12	20 0036	9.8	0.4		197	6.95	81	0.200	0.120	0.035	0.025
	12	20 0043	7.9	0.4		197	6.93	82	0.140	0.240	0.066	0.047
	12	20 0050	7.3	0.2		200	6.95	82	0.140	0.240	0.066	0.047

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	12	20 0000	2.8J

J VALUE KNOWN TO BE LESS THAN

STORET RETRIEVAL DATE 74/10/30

278808
47 17 10.0 093 09 35.0
SWAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0029 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/09/09	10 10	0000				198	7.83	78	0.030	0.060	0.010	0.006
	10 10	0004	17.8	8.6		195	7.85	77	0.030	0.050	0.013	0.008
	10 10	0015	17.7	8.3		188	7.82	81	0.030	0.060	0.013	0.006
	10 10	0020	17.5	7.6		190	7.68	79	0.040	0.060	0.010	0.005
	10 10	0025	17.1	9.9		188	7.60	76	0.040	0.060	0.010	0.005

27

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/09/09	10 10	0000	4.9J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/30

27HRA1 LS27HRA1
47 17 00.0 093 16 00.0
SWAN RIVER
27 7.5 CALUMET
O/SWAN LAKE
HD HRDG 2.5 MI S OF CALUMET
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2AND3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	09 20		0.016	0.450	0.056	0.005K	0.022
72/11/19	14 20		0.018	0.520	0.046	0.009	0.016
73/03/17	13 30		0.140	0.420	0.042	0.014	0.020
73/04/05	09 05		0.012	1.260	0.014	0.005K	0.025
73/04/19	09 55		0.024	0.650	0.056	0.007	0.030
73/05/05	10 30		0.010K		0.042	0.005K	0.015
73/05/20	11 15		0.013	0.420	0.005K	0.006	0.035
73/06/14	10 15		0.01JK	1.400	0.022	0.015	0.025
73/07/26	14 45		0.014	0.540	0.025	0.012	0.025
73/08/20	13 55		0.015	0.460	0.019	0.011	0.020
73/10/03	14 20		0.010K	1.380	0.047	0.009	0.020

K VALUE KNOWN TO BE LESS
THAN INDICATED

29

STORET RETRIEVAL DATE 74/10/30

278841 LS278841
47 16 30.0 093 09 30.0
UNNAMED OUTLET OF HART LAKE
27 7.5 PENGILLEY
T/SWAN LAKE
CO HWY 12 BRDG UPSTREAM OF SWAN LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 15		0.039	0.450	0.058	0.005K	0.014
72/11/19	11 10		0.034	0.440	0.054	0.006	0.016
73/03/17	11 00		0.154	1.000	0.048	0.008	0.015
73/04/05	11 05		0.022	0.990	0.010	0.005K	0.025K
73/04/19	12 35		0.037	1.600	0.046	0.006	0.035
73/05/05	12 45		0.015	0.420	0.021	0.005K	0.020
73/05/20	12 00		0.014	0.420	0.005K	0.005K	0.020
73/06/14	11 30		0.010K	0.720	0.011	0.008	0.015
73/07/26	20 26		0.010K	0.520	0.015	0.008	0.015
73/08/20	14 35		0.010K	1.630	0.027	0.008	0.010
73/10/03	15 15		0.010K	0.630	0.034	0.007	0.010

K VALUE KNOWN TO BE LESS
THAN INDICATED

30

STORET RETRIEVAL DATE 74/10/30

27RAC1 LS27RAC1
47 17 30.0 093 09 00.0
HAY CREEK
27 7.5 PENGILLY
T/SWAN LAKE
CO HWY 12 BRDG .25 MI UPSTREAM SWAN LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 10		0.032	0.650	0.063	0.013	0.040
72/11/19	14 00		0.039	0.440	0.071	0.010	0.034
73/04/05	10 55		0.076	2.100	0.060	0.014	0.060
73/04/19	12 30		0.017	2.900	0.073	0.022	0.080
73/05/05	13 30		0.015	1.050	0.020	0.00K	0.040
73/05/20	11 55		0.01K	1.150	0.023	0.00K	0.040
73/06/14	11 15		0.022	1.300	0.034	0.019	0.040
73/07/26	20 22		0.010K	0.920	0.020	0.01K	0.040
73/08/20	14 35		0.011	2.700	0.077	0.022	0.040
73/10/03	15 05		0.010K	1.490	0.056	0.023	0.040

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

278801 LS278801
47 18 30.0 093 10 00.0
O'BRIEN CREEK
27 7.5 PENGILLY
I/SWAN LAKE
CO HWY 12 BRDG 2 MI SE PENGILLY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO3&NO2 I-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	09 00		1.800	0.350	0.100	0.060	0.130
72/11/19	10 55		2.117	0.630	0.052	0.024	0.063
73/03/17	10 45		0.294	1.680	0.357	0.080	0.170
73/04/05	10 00		0.072	1.940	0.046	0.023	0.075
73/04/19	12 20		0.011	1.899	0.042	0.016	0.072
73/05/05	12 40		0.010K	0.720	0.025	0.019	0.060
73/05/20	11 50		0.010K	0.660	0.005K	0.021	0.055
73/06/14	11 05		0.011	1.150	0.039	0.048	0.075
73/07/26	20 15		0.056	1.130	0.063	0.046	0.080
73/08/20	14 40		1.031	2.550	0.088	0.046	0.070
73/10/03	14 57		0.010K	0.860	0.030	0.026	0.050

K VALUE KNOWN TO BE LESS THAN INDICATED

32

STORET RETRIEVAL DATE 74/10/30

2788E1 LS2788E1
47 23 30.0 093 04 00.0
WELCOME CREEK
27 7.5 KEEWATIN
T/SWAN LAKE
CO HWY 16 XING SE KEEWATIN ABOVE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 45		0.890	0.250	0.066	0.005K	0.017
72/11/19	09 55		0.195	0.460	0.110	0.005K	0.018
73/04/05	11 30		0.120	1.400	0.067	0.005K	0.025
73/04/19	10 25		0.115	1.730	0.100	0.005K	0.020
73/05/05	10 55		0.300	0.440	0.040	0.005K	0.015
73/05/20	13 15		0.600	0.290	0.014	0.005K	0.020
73/06/14	11 40		0.072	1.300	0.189	0.052	0.100
73/07/26	20 51		0.089	0.520	0.078	0.013	0.075
73/08/20	15 36		0.050	0.500	0.088	0.023	0.120
73/10/03	15 35		0.700	2.000	0.022	0.006	0.025

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

2788E2 LS2788E2
47 22 30.0 093 04 30.0
WELCOME CREEK
27 7.5 SILICA
T/SWAN LAKE
AT CULVERT 0.75 MI N CO RDS16 & 531
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	12 50		0.740	0.250	0.105	0.039	0.097
72/11/19	10 00		0.590	1.150	0.580	0.014	0.205
73/03/17	10 10		0.540	1.890	0.730	0.050	0.260
73/04/05	09 35		0.410	2.520	0.830	0.054	0.335
73/04/19	10 30		0.350	3.400	0.615	0.027	0.180
73/05/05	11 05		0.450	1.400	0.600	0.036	0.260
73/05/20	13 30		0.760	0.800	0.252	0.066	0.280
73/06/14	11 50		0.740	1.380	0.410	0.073	0.250
73/07/26	20 56		0.360	1.100	0.294	0.062	0.230
73/08/20	16 42		0.690	1.100	0.505	0.042	0.102
73/10/03	15 40		0.910	1.050	0.240	0.050	0.130

47

STORET RETRIEVAL DATE 74/10/30

2788G1 LS2788G1
47 20 00.0 093 11 30.0
PICKEREL CREEK
27 7.5 PENGILLY
T/SWAN LAKE
CO HWY 12 CROSSING NE OF PENGILLY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 50		0.377	0.200	0.064	0.007	0.020
72/11/19	10 45		0.360	0.400	0.048	0.006	0.019
73/03/17	10 40		1.200	0.480	0.052	0.013	0.047
73/04/05	10 40		0.430	1.540	0.036	0.006	0.025
73/04/19	12 10		0.240	3.000	0.132	0.010	0.035
73/05/05	12 20		0.294	0.370	0.032	0.009	0.025
73/05/20	11 45		0.090	0.660	0.016	0.011	0.030
73/06/14	10 55		0.399	0.560	0.056	0.021	0.035
73/07/26	20 08		0.080	0.440	0.038	0.013	0.030
73/08/20	14 50		0.140	1.470	0.140	0.017	0.025
73/10/03	14 50		0.240	1.150	0.027	0.011	0.030

35

STORET RETRIEVAL DATE 74/10/30

27BBH1 LS27BBH1
47 19 30.0 093 12 00.0
OXHIDE CREEK
27 7.5 PENGILLY
T/SWAN LAKE
AT ST HWY 65 XING S OF PENGILLY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 45		0.830	0.400	0.160	0.005K	0.015
72/11/19	11 25		0.821	0.400	0.115	0.005K	0.011
73/03/17	11 10		1.240	0.390	0.052	0.009	0.030
73/04/05	10 35		1.220	1.540	0.035	0.005K	0.005K
73/04/19	12 45		1.150	3.700	0.210	0.006	0.025
73/05/05	13 00		1.020	0.580	0.044	0.006	0.015
73/05/20	11 40		0.900	0.430	0.035	0.007	0.025
73/06/14	10 50		0.770	0.840	0.044	0.009	0.015
73/07/26	20 05		0.380	0.420	0.029	0.009	0.020
73/08/20	15 00		0.294	0.420	0.044	0.010	0.020
73/10/03	14 45		0.273	1.100	0.025	0.132	0.135

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

2788J1 LS2788J1
47 19 30.0 093 14 00.0
SNOWBALL CREEK
27 7.5 PENGILLY
T/SWAN LAKE
CO HWY 529 XING 1.5 MI WSW PENGILLY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 30		0.103	0.450	0.128	0.008	0.023
72/11/19	11 30		0.164	0.500	0.115	0.007	0.020
73/04/05	10 30		0.024	1.050	0.015	0.005K	0.015
73/04/19	12 50		1.100	0.880		0.006	0.025
73/05/05	13 15		0.034	0.360	0.022	0.006	0.020
73/05/20	11 30		0.030	0.520	0.079	0.007	0.030
73/06/14	10 35		0.018	0.900	0.020	0.015	0.025
73/07/26	20 00		0.050	0.480	0.025	0.019	0.035
73/08/20	14 10		0.088	0.500	0.050	0.027	0.040
73/10/03	14 37		0.046	0.330	0.023	0.022	0.035

K VALUE KNOWN TO BE LESS THAN INDICATED

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STORET RETRIEVAL DATE 74/11/20

278851 AS278851 P001341
47 23 00.0 093 10 00.0
NASHWAUK
27 7.5 PENGILLY
T/SWAN LAKE
OBRIEN CREEK
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/07/02	10 30								
CP(T)- 73/07/02	12 30		0.950	12.000	0.400	3.170	5.750		
73/07/25	10 00								
CP(T)- 73/07/25	12 00		1.940	10.000	0.320	1.150	2.400	0.190	0.165
73/08/29	10 00								
CP(T)- 73/08/29	12 00		0.890	12.400	0.390	5.350	8.200		0.135
73/09/17	10 00								
CP(T)- 73/09/17	24 00		6.200	11.000	0.320	6.160	7.600		
73/10/24	11 00								
CP(T)- 73/10/24	13 00		7.400	9.600	0.023	5.200	5.900	0.126	0.135
73/11/29	11 00								
CP(T)- 73/11/29	13 30		11.800	6.430	0.140	4.200	5.300	0.108	0.116
73/12/21	10 30								
CP(T)- 73/12/21	12 30		10.000	10.000	0.270	4.400	6.700	0.228	0.162
74/02/19			7.560	4.450	0.640	3.000	4.050	0.248	0.269
74/03/19	10 30								
CP(T)- 74/03/19	12 30		6.410	7.600	3.250	3.000	5.250	0.305	0.315
74/04/15	10 00								
CP(T)- 74/04/15	24 00		3.020	9.500	0.490	1.700	3.400	0.296	0.272
74/05/30	10 30								
CP(T)- 74/05/30	12 30		3.210	12.000	0.240	2.500	3.900	0.195	0.199
74/06/17	09 30								
CP(T)- 74/06/17	11 30		2.060	11.000	0.190	2.400	4.100	0.163	0.390
74/07/15	09 30								
CP(T)- 74/07/15	11 30		0.180	4.340	0.050K	2.400	4.200	0.151	0.495

K VALUE KNOWN TO BE LESS THAN INDICATED

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